REVERSIBILITY OF THE REACTIONS OF PLANARIA DOROTOCEPHALA TO A CURRENT OF WATER.

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CONTENTS.

I. INTRODUCTION.

A reaction of planarians to currents of water has been described by Pearl ('03) in his careful study of the general features of the behavior of planarians. He has described the reaction and his method of obtaining it as follows: "In the course of the experiments to localize chemical stimuli by the capillary tube method, it was discovered that by means of a tube with a relatively large opening (from .25 to .50 mm. in diameter) and letting the ordinary tap-water in which the animals were flow out of it by its own weight, a current of just the right intensity to cause a positive reaction could be produced. The animals would turn very sharply toward the source of such a current, the reaction being evidently the same as that to other weak stimuli (chemical and mechanical). This reaction is localized in the same way as the usual positive reaction. It is given only when the current is directed against the head or anterior part of the body" (p. 698). He states that earlier in his work a large number of experiments were performed with various devices to determine whether these animals would show such a reaction, but without success. Streams of water from a

pipette and similar devices caused only a stopping, longitudinal contraction, and gripping of the bottom without any turning either toward or away from the source of the stimulus.

That the rheotropic reactions of planarians were found so difficult to demonstrate, it seems probable, must have been due to the experimental methods employed. Using the methods described below, it has been found that rheotropic reactions of these animals can be demonstrated very easily, not only in a "current of just the right intensity" but in currents of a large range of intensities. Under the conditions of these methods a worm is entirely surrounded by the flowing water on all surfaces except the ventral surface which is attached to the substratum, and the conditions of stimulation are more typically rheotropic than when the stream of water is directed as a small jet against a localized part of the body. A negative reaction, *i. e.*, a turning away from the side stimulated, was not described by Pearl but Dr. C. M. Child, who suggested this study, has observed a negative reaction as well as a positive reaction in currents of water in his laboratory stocks of worms used in studies in regeneration. It has been found that these reactions are reversible experimentally. The study of their reversibility which is reported in the present paper was preliminary to a more detailed study of the rheotropism of these animals which is in progress at the present time.

The work reported in the present paper was done some time ago in the zoölogical laboratory of the University of Chicago. My acknowledgments are due Dr. C. M. Child and Dr. V. E. Shelford for helpful suggestions.

II. Material and Methods.

Planaria dorotocephala has been used exclusively for this study. Specimens were collected from a spring-fed marsh at the margin of the Fox River near Chicago, Illinois. These animals are very easy to keep in the laboratory without special care. Since this study was in the nature of a testing of the reaction possibilities of the worms toward currents of water, rather than an effort to determine the normal habits, no efforts were made to duplicate the normal conditions of existence in

nature. Specimens were kept in large numbers in glass and galvanized iron containers which were emptied of water, rinsed and filled with fresh tap-water from time to time without removing the worms which cling to the surface of the vessel. They were fed two or three times a week with fresh beef cut into small bits and left in the dish for several hours or during the night. These worms collect on fresh meat and secure blood and juices but it is very improbable that they are able to make use of the solid portions.

Rheotropic reactions were tested in a "circular current" as follows: A considerable number of specimens, sometimes several hundred, were placed in a circular shaped vessel such as a glass battery jar or a kitchen pan and the water was stirred vigorously around the dish several times with a stirring rod. Vigorous stirring usually dislodged the most of the specimens which were then swept into a bunch at the center of the current. If they were not dislodged by the stirring, they were loosened by means of more vigorous streams of water from a large bulbed pipette. The movements of the animals on the bottom of the vessel only were studied since those on the sides were in a different relation to gravity which introduced a geotropic factor into the reaction. Rheotropism has been observed, however, in worms gliding on vertical surfaces.

It was found convenient to have all the specimens, or the larger part of them, enter the experiment at the center of the "circular current" since they were then all placed under similar conditions. In whatever direction any worm started out from the center, it would receive the current against the same side of the body as all the other worms starting from the center. If the current were stirred in the clockwise direction, for example, all the worms starting from the center of the dish would receive the current against the left side of the body. If they gave a positive reaction, they turned toward the left side; that is, toward the side stimulated, or up-stream, and if they gave a negative reaction, they turned toward the right side; that is, away from the side stimulated, or down-stream. When a large number of worms were gliding on the bottom of the dish, if their reactions were uniform, a very striking figure was produced.

This is illustrated in Figs. 1 and 2. Fig. 1 is a photograph of a lot of worms in a dish pan, reacting positively to a current stirred in the clockwise direction. The conspicuous spiral form of the figure is characteristic of the positive reaction. Fig. 2 is a photograph showing the characteristic negative reaction near the center of the pan.

These peculiar and characteristic spiral figures in a "circular current" called for a more careful examination of the physical conditions in the experiment, which revealed the fact that the worms were subjected to a system of spiral currents instead of a circular current. If a drop of a water suspension of carmine is placed on the bottom of a dish in which the water has been stirred in this way, the carmine in the lower layers of water close to the bottom will be seen to stream inward along a spiral course toward the center. Fig. 3 is a photograph of a dish pan in which the water was stirred in the clockwise direction and then drops of carmine were placed on the bottom at eleven points around its circumference. The carmine was dragged along by the currents and left streaks on the bottom of the pan which show as spiral lines in the photograph. The worms were subjected to this spiral system of currents. Carmine in the upper layers of water was swept about the dish in a fairly circular direction, and the water which flowed along the spiral lines on the bottom toward the center, rose, as it neared the center, and spread outward above.

A comparison of Fig. 3 with Fig. 1 shows that the spiral lines of the currents and the spiral lines of the positive reaction are alike. This explains, therefore, the spiral character of the reaction. The worms orient themselves to a spiral current. A comparison of Fig. 2 with Fig. 3 shows that in the usual negative reaction the direction taken is away from the side stimulated, but rather diagonally than directly down-stream. In some cases, however, when worms were distributed over the bottom and were not dislodged by the stirring, they were observed to turn inward and follow along the lines of the spiral current in as precise a negative orientation as was often characteristic of the positive reaction.

A mixture of definitely positive and definitely negative re-

UN NOUVEAU GENRE AFRICAIN *OREONESION* A. Rayn. *(GENTIANACEAE).*

par ALINE RAYNAL

Une grande Gentianacée, récoltée d'abord par LE TESTU en 1933, puis par DAVIS et ANTON SMITH en 1957 dans la même région du Gabon, s'est révélée, à l'étude, indéterminable. C'est une annuelle dressée à feuilles charnues et glomérules de fleurs blanches, croissant sur les croupes rocheuses dénudées qui percent la forêt du Nord-Ouest du Gabon, aux confins du Cameroun et du Rio Muni.

Un certain nombre de caractères permettait de rapprocher cette plante du genre *Enicostema* : — l'inflorescence en glomérules axillaires correspondant à des cymes axillaires contractées — les filets staminaux ornés à leur base d'un renflement — le pollen de taille moyenne, en grains isolés tricolpés.

Mais d'autres caractères, auxquels une large place est habituellement accordée dans la classification de la famille, tels que : — le stigmate bilabié et non capité — la base des filets staminaux renflée en boule et non ornée d'une écaille en lame ou en éteignoir — les anthères à connectif non prolongé, écartaient la plante gabonaise des *Enicostema*, qui sont tous très homogènes en ce qui concerne ces caractères.

Outre ces traits majeurs, des caractères mineurs, que l'on peut qualifier de spécifiques, rendent plus aisée la distinction immédiate entre notre plante et les *Enicostema* : — les fleurs toujours tétramères — les feuilles charnues, de taille décroissante vers le haut des rameaux — l'absence de replis interstaminaux au niveau d'insertion des étamines sur la corolle.

Le genre *Enicostema* est encore totalement inconnu en Afrique Occidentale et Centrale : il ne dépasse pas l'Angola [1].

Je pense donc que la création d'un nouveau genre de *Gentianaceae (Gentianae-Erythraeinae)* se justifie.

OREONESION A. Rayn., *gen. nov.* [2].

Herba foliis oppositis vel verticillatis. Inflorescentia e cymis contractis axillaribus composita. Flores regulares. Filamenta basi inflata rotundata.

1. *Enicostema littorale* Bl. a été signalé en Gambie par BAKER, Kew Bull. : 273 (1891); BAKER et BROWN, in DYER, Fl. Trop. Afr., **4**, 1 : 563 (1903); HUTCHINSON et DALZIEL, Fl. W. Trop. Afr., **2**, 1 : 184 (1931); P. TAYLOR, in HUTCHINSON et DALZIEL, Fl. W. Trop. Afr., **2**, 2nd ed. : 302 (1963). Mais il semble bien que cela corresponde à une erreur de détermination (BAKER, 1891), recopiée par la suite (HEPPER, *in litt.*).

2. De ὄρος, montagne, et νῆσος, île, d'après l'écologie des spécimens connus, qui croissent sur des inselbergs.

Antherae biloculares, connectivo non loculos superante. Grana pollinaria separata, ovoidea, tricolpa. Ovarium uniloculare ovulis numerosis. Stylus unicus, stigmata bilabiata.

Enicostemae affinis.

Species typica : *O. Testui* A. Rayn.

Dans le cadre de la classification des *Gentianaceae* établie par Gilg (in Engler et Prantl, Nat. Pflanzenfam., **4**, 2 (1895), le genre *Oreonesion* se place dans la tribu des *Erythraeinae*, à proximité du genre *Enicostema*. La clef des genres de cette tribu (Gilg, loc. cit. : 66, traduit) peut être modifiée ainsi :

A. Graines insérées uniquement sur les bords carpellaires (placentas) plus ou moins intrusifs.

a. Fleurs nombreuses, régulières, toutes les étamines fertiles.

α. Base de l'étamine élargie en un organe glanduleux

+. Stigmate capité..... 6 . *Enicostema*

++. Stigmate bilabié..... 6'. *Oreonesion*

β. Filet staminal filiforme ou tout au plus à peine élargi à la base.

I. Stigmate capité ou en massue, parfois faiblement lobé (5 genres)

II. Stigmate nettement et profondément bilabié (6 genres)

Le genre *Oreonesion* n'est encore connu que par l'espèce-type :

Oreonesion Testui A. Rayn., *sp. nov.* [3].

Herba annua, erecta. Folia opposita vel ternata, crassa, lanceolata, sessiles. Inflorescentia e fasciculis sessilibus cymosis contractis composita. Flores 4-meri. Calyx campanulatus, 4 mm longus, sepalis dorso leviter alatis. Corolla alba, tubo 5 mm longo, quadricostato, costis bifurcatis sub ore; lobis 4 lanceolatis acutis, 3,5 mm longis. Stamina exserta, paulo infra orem corollae posita; basis filamenti inflata, rotundata, papillosa, verisimiliter glandulosa. Anthera introrsa, bilocularis, fissis lateralibus dehiscens. Gynoecium carpellis 2; ovarium parum depressum, placentis leviter introgressis, ovulos numerosos gerentibus. Stylus simplex, stigmata bilabiata papillosa.

Holotypus : Le Testu 8972, rocher de Salem, à Elelem, Gabon, région entre Ogooué et Cameroun, 15 janvier 1933; fleurs blanches (P).

Autre échantillon connu : J.M.G. Davis et J. Anton Smith 242, Gabon, 30 km north of Oyem, alt. 750 m, 8 août 1957; open grassy domed hill. Flowers white.

Grande annuelle dressée, d'environ 80 cm de haut; tige unique à la base, portant quelques longs rameaux divariqués. Cette tige, ronde, rigide, épaisse à la base de 5 mm, s'amincit graduellement vers le sommet

3. Espèce dédiée à M. Le Testu qui, le premier, récolta cette plante.